

3. Estimation and Registration of Projects

As part of the project proposal (design) stage, project developers describe the project activities intended to reduce energy use and carbon emissions, establish a project baseline, estimate the project's carbon and monetary returns, and design a monitoring and evaluation plan. In Figure 3, we present an overview of the approach used in this report in estimating gross and net changes in energy use and emissions. In this section, we focus on the issues involved in estimating the baseline and gross changes in energy use and carbon emissions, since the net change is simply the difference between the gross change and the baseline.

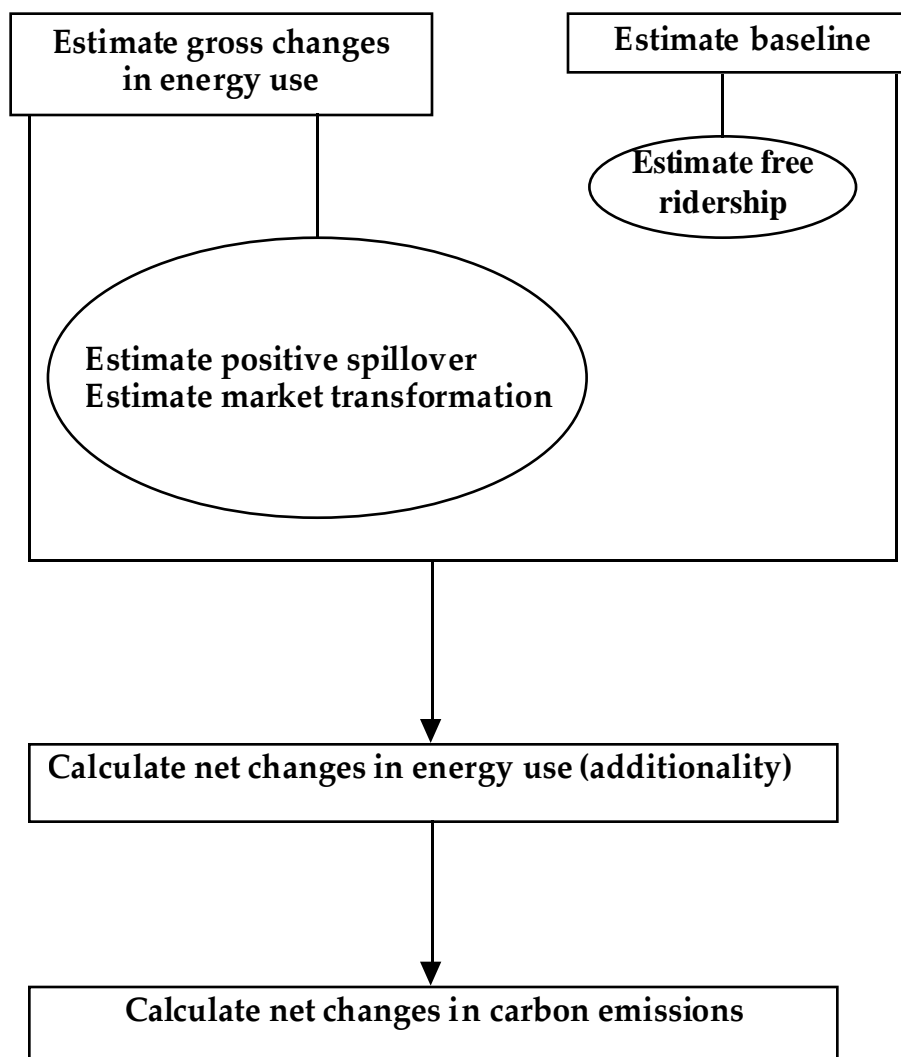


Fig. 3. Estimation Overview

The monitoring and evaluation plan describes the type of data to be collected, the data collection activities (procedures and methods) to be undertaken, and how the data will be evaluated. The plan also specifies the equipment and organizational requirements for monitoring and evaluation. The monitoring and evaluation plan is an integral part of the implementation of the project and should produce more accurate estimates of impacts at a lower cost. The results from the monitoring will later be used to re-estimate the baseline. In Appendix A, we provide an Estimation Reporting Form for project developers to use when designing an energy-efficiency project. The intent of this form is to provide guidance to developers on issues that evaluators and verifiers will examine after a project is implemented.

3.1. Estimating Gross Changes in Energy Use and Carbon Emissions

At the project design stage, changes in energy use and carbon emissions will be estimated by using one or more techniques: (1) modeling, (2) review and analysis of the literature on similar projects (content analysis), (3) review and analysis of data from similar projects recently undertaken; and (4) expert judgement. The estimation methodology can be either simple or complex, depending on the resources available for conducting the estimation and the concern for reliable results (Watt et al. 1995). Since many assumptions need to be made, project estimates are later compared with measured data to determine the accuracy and precision of the estimated changes in energy use and carbon emissions. The key issues that need to be addressed in estimating gross changes are: (1) determining the appropriate monitoring domain, and (2) accounting for positive project spillover and market transformation.

3.1.1. Monitoring domain

The domain that needs to be monitored (i.e., the monitoring domain, see Andrasko 1997 and MacDicken 1997) is typically viewed as larger than the geographic and temporal boundaries of the project. In order to compare GHG reductions across projects, a monitoring domain needs to be defined. Consideration of the domain needs to address the following issues: (1) the temporal and geographic extent of a project's direct impacts; and (2) coverage of positive project spillover and market transformation.

The first monitoring domain issue concerns the appropriate geographic boundary for evaluating and reporting impacts. For example, an energy project might have local (project-specific) impacts that are directly related to the project in question, or the project might have more widespread (e.g., regional) impacts (leading to positive project spillover and market transformation, see Sections 3.1.2

and 3.1.3). Thus, one must decide the appropriate geographic boundary for evaluating and reporting impacts. Also, energy projects may impact energy supply and demand at the point of production, transmission, or end use. The MERVIC of such impacts will become more complex and difficult as one attempts to monitor how emission reductions are linked between energy end users and energy producers (e.g., tracking the emissions impact of 1,000 kWh saved by a household in a utility's generation system).

The second issue concerns coverage of positive project spillover, as discussed in the next section. It is important to note that not all secondary impacts can be predicted. In fact, many secondary impacts occur unexpectedly and cannot be foreseen. And when secondary impacts are recognized, a commitment needs to be made to ensure that resources are available to evaluate these impacts.

One could broaden the monitoring domain to include off-site baseline changes (which are normally perceived as occurring outside the monitoring domain). Widening the system boundary, however, will most likely entail greater MERVIC costs (see Section 9) and could bring in tertiary and even less direct effects that could overwhelm any attempt at project-specific calculations (Trexler and Kosloff 1998). Consequently, project developers should devote most of their resources to the immediate monitoring domain. During the monitoring and evaluation stage, the monitoring domain can be expanded if warranted.

3.1.2. Positive project spillover

For most projects, the number of eligible nonparticipants is far greater than the number of participants. Thus, when measuring energy savings, it is possible that the actual reductions in energy use are greater than measured because of changes in participant behavior not directly related to the project, as well as to changes in the behavior of other individuals not participating in the project (i.e., nonparticipants). These secondary impacts stemming from an energy-efficiency project are commonly referred to as "positive project spillover." Positive project spillover may be regarded as an unintended consequence of an energy-efficiency project; however, as noted below, increasing positive project spillover may also be perceived as a strategic mechanism for reducing GHG emissions.

Spillover effects can occur through a variety of channels including: (1) an individual hearing about a project measure from a participant and deciding to pursue it on his or her own ("free drivers"); (2) project participants that undertake additional, but unaided, energy-efficiency actions based on positive experience with the project; (3) manufacturers changing the efficiency of their products, or retailers and wholesalers changing the composition of their inventories to reflect the demand for

more efficient goods created through the project; (4) governments adopting new building codes or appliance standards because of improvements to appliances resulting from one or more energy efficiency projects; or, (5) technology transfer efforts by project participants which help reduce market barriers throughout a region or country.

Because of the multiple actors that may be involved in causing positive project spillover, it is unclear on how much of these changes should be attributed to the project developer. Since spillover is an unintended consequence, and the project developer is a passive recipient of the benefits of spillover, it should not be his responsibility for expending resources for an assessment of project spillover. Project spillover still needs to be evaluated, but not assessed in the estimation stage.

3.1.3. Market transformation

Project spillover is related to the more general concept of “market transformation,” defined as: “the reduction in market barriers due to a market intervention, as evidenced by a set of market effects, that lasts after the intervention has been withdrawn, reduced or changed” (Eto et al. 1996). In contrast to project spillover, increasing market transformation is expected to be a strategic mechanism (i.e., an intended consequence) for reducing GHG emissions for the following reasons:

- To increase the effectiveness of energy-efficiency projects: e.g., by examining market structures more closely, looking for ways to intervene in markets more broadly, and investigating alternative points of intervention.
- To reduce reliance on incentive mechanisms: e.g., by strategic interventions in the market place with other market actors.
- To take advantage of regional and national efforts and markets.
- To increase focus on key market barriers other than cost.
- To create permanent changes in the market.

Market transformation has emerged as a central policy objective for future publicly funded energy-efficiency projects in the United States, but the evaluation of such projects is still in its infancy. Furthermore, regulatory authorities have little experience in accepting savings from market transformation. Nevertheless, because of its importance, we encourage project developers to consider savings from market transformation, particularly since other countries are starting to implement market transformation programs (see Box 2).

Box 2**Market Transformation Programs Outside North America**

Market transformation programs are being implemented outside of North America, particularly in Sweden, Brazil, Thailand, India, Philippines, Sri Lanka, Poland, and China (Martinot 1998; Meyers 1998). We provide information on market transformation programs for the first three countries.

The ten-year old Swedish program for energy efficiency has produced 25 procurements within the residential, commercial and industrial sectors (Suvilehto and Öfverholm 1998). Examples in the residential sector include refrigerators and freezers, washing machines and dryers; in the commercial sector, lighting and ventilation; and in the industrial sector: factory doors and fans. This program aims at establishing market transformation and consists of technology procurement and projects supporting market penetration. There is a wide variety of methods in use; each of them are designed according to the market barriers, its actors, decision makers, their interplay, and specific market needs, expectations and conditions.

Since 1995, Brazil's national electricity conservation program, PROCEL, has been involved in market transformation, including cooperative efforts with equipment manufacturers (Geller 1997). PROCEL has had considerable success in transforming the efficiency of refrigerators and freezers, lighting, motors, and meters. PROCEL conducts or co-funds several other programs in the areas of research and development, consumer education, training, promotion and ESCO support. These programs are designed to introduce new technologies, increase awareness, change behavior, and stimulate investment in energy efficiency in Brazil.

The Thailand Promotion of Electricity Efficiency project is a comprehensive five-year utility DSM program that created a DSM office within the national electric utility (EGAT) (Martinot 1998). The DSM office is developing and implementing a number of market intervention strategies in the residential, commercial and industrial sectors. The project provides for financing mechanisms, energy-efficiency codes and standards, appliance labeling, testing laboratories, monitoring and evaluation protocols and systems, development and training of energy service companies, integrated supply-side and demand-side planning, and load management programs. EGAT has tried to rely on voluntary agreements, market mechanisms, and intensive publicity and public education campaigns (including appliance energy labels).

Sources: (1) Suvilehto, H. and E. Öfverholm. 1998. "Swedish Procurement and Market Activities — Different Design Solutions on Different Markets," in the *Proceedings of the 1998 ACEEE Summer Study on Energy Efficiency in Buildings*. Vol. 7, pp. 311-322. Washington, D.C.: American Society for an Energy-Efficient Economy. (2) Geller, H. 1997. *Market Transformation through PROCEL: Brazil's National Electricity Conservation Program*. Washington, D.C.: American Council for an Energy-Efficient Economy. (3) Martinot, E. 1998. *Monitoring and Evaluation of Market Development in World Bank-GEF Climate Change Projects*. Washington, D.C.: The World Bank. (4) Meyers, S. 1998. *Improving Energy Efficiency: Strategies for Supporting Sustained Market Evolution in Developing and Transitioning Countries*. LBNL-41460. Berkeley, CA: Lawrence Berkeley National Laboratory.

In the case of market transformation, the project developer is one of the responsible parties for engendering energy-use changes and, therefore, should be responsible for estimating the amount of market transformation. However, because of the multiple actors involved in causing market transformation, the developer should not be solely responsible for assessing and later monitoring and

evaluating market transformation.¹ The amount of resources devoted to assessing market transformation, therefore, will depend on how much energy savings can be attributed to this project, which may be reflected in contracts among parties involved in transforming markets.

3.2. Estimating a Baseline

For joint implementation (Article 6) and Clean Development Mechanism (Article 12) projects implemented under the Kyoto Protocol, the emissions reductions from each project activity must be “additional to any that would otherwise occur,” also referred to as “additionality criteria” (Articles 6.1b and 12.5c).² Determining additionality requires a baseline for the calculation of energy saved, i.e., a description of what would have happened to energy use had the project not been implemented (see Violette et al. 1998). Additionality and baselines are inextricably linked and are a major source of debate (Trexler and Kosloff 1998). Determining additionality is inherently problematic because it requires resolving a counter-factual question: What would have happened in the absence of the specific project?

Because investors and hosts of energy-efficiency projects have the same interest in an energy-efficiency project (i.e., they want to get maximum energy savings from the project), they are likely to overstate and over-report the amount of energy saved by the project (e.g., by overstating business-as-usual energy use). Cheating may be widespread if there is no strong monitoring and verification of the projects. Even if projects are well monitored, it is still possible that the real amount of energy saved is less than estimated values. Hence, there is a critical need for the establishment of realistic and credible baselines.

¹ Other challenges in proving attribution include the following: (1) multiple interventions occur (e.g., changes in standards, products offerings and prices and activities of other market actors (e.g., regulators and regulatory intervenors)); (2) programs and underlying change factors interact with one another; (3) the effects of different programs are likely to have different lag times; (4) changes in different technologies are likely to proceed along different time paths; (5) changes are likely to differ among different target segments; (6) the lack of an effective external comparison group; (7) data availability; and (8) large, complex interconnected sociotechnical systems are involved, with different sectors changing at different rates and under different influences.

² In this report, the criterion of additionality refers only to carbon emissions. The related criterion of “financial additionality” is not described in LBNL’s MERVC guidelines. Financial additionality refers to the financial flows of a project (Andrasko et al. 1996): would the expenditures involved been made without the energy-efficiency project? This question addresses: (1) the sources of funding for the project, (2) the alternative uses of that funding, and (3) the motivation for choosing the energy-efficiency projects (Swisher 1998). We expect financial additionality to be addressed when the proposed project is registered (see Section 1.1).

Future changes in energy use may differ from past levels, even in the absence of the project, due to growth, technological changes, input and product prices, policy or regulatory shifts, social and population pressure, market barriers, and other exogenous factors. Consequently, the calculation of the baseline needs to account for likely changes in relevant regulations and laws, changes in key variables (e.g., population growth or decline, and economic growth or decline) (Andrasko et al. 1996; Michaelowa 1998).

Ideally, when first establishing the baseline, energy use should be measured for at least a full year before the date of the initiation of the project. The baseline will be re-estimated based on monitoring and evaluation data collected during project implementation. Finally, in order to be credible, project-specific baselines need to account for free riders.

3.2.1. Free riders

In energy-efficiency projects, it is possible that the reductions in energy use are undertaken by participants who would have installed the same measures if there had been no project. These participants are called “free riders.” The savings associated with free riders are not truly “additional” to what would occur otherwise (Vine 1994). Although free riders may be regarded as an unintended consequence of an energy-efficiency project, free ridership should still be estimated, if possible, during the estimation of the baseline (Section 4.3). Although many studies have been able to estimate the number of free riders, some studies have not been able to find any free riders: e.g., in Texas, an independent evaluation of all state agencies participating in the Texas LoanSTAR program¹ showed virtually no free ridership (personal communication from Jeff Haberl, Texas A&M University, Jan. 13, 1999). While free riders can also cause positive project spillover, this impact is typically considered to be insignificant compared to the impacts from other participants.

For projects installing energy-efficient technologies in developing countries where the efficiency of these technologies would be regarded as “conventional” in developed countries, all project participants could be regarded as free riders. As a result, there would be few projects implemented. A possible solution to this problem would be the establishment of performance benchmarks (standards) that would indicate to project developers the type of energy-efficient equipment that would be allowed to be installed and that would pass the “free rider test” (Section 3.2.2).

¹ The Texas LoanSTAR program is a \$98.6 million revolving loan program that was created to provide public funds for energy-efficiency retrofits to state, local government, and school district buildings within Texas (Verdict et al. 1990; Claridge et al. 1991; Haberl et al. 1996).

3.2.2. Performance benchmarks

Concerned about an arduous project-by-project review that might impose prohibitive costs, some researchers have proposed an alternate approach, based on a combination of performance benchmarks and procedural guidelines that are tied to appropriate measures of output (e.g., Lashof 1998; Michaelowa 1998; Swisher 1998; Trexler and Kosloff 1998). In all cases, measurement and verification of the actual performance of the project is required. The performance benchmarks for new projects could be chosen to represent the high performance end of the spectrum of current commercial practice (e.g., representing roughly the top 25th percentile of best performance). In this case, the benchmark serves as a goal to be achieved. In contrast, others might want to use benchmarks as a reference or default baseline: an extension of existing technology, and not representing the best technology or process.

A panel of experts could determine a baseline for a number of project types, which could serve as a benchmark for the UNFCCC. This project categorization could be expanded to a categorization by regions or countries, resulting in a region-by-project matrix. Project developers could check the relevant element in the matrix to determine the baseline of their project. Most of the costs in this approach relate to the establishment of the matrix and its periodical update. Before moving forward with this approach, analysis is needed to consider the costs in developing the matrix and its update, the potential for projects to qualify, and the potential for free riders. The U.S. EPA is assessing the feasibility and desirability of implementing a benchmark approach for evaluating additionality (e.g., see Hagler Bailly 1998).

3.3. Estimating Net GHG Emissions

Once the net energy savings have been calculated (i.e., estimated gross energy use minus baseline energy use), net GHG emissions reductions can be estimated in one of two ways: (1) if emissions reductions are based on fuel-use or electricity-use data, then default emissions factors can be used, based on utility or nonutility estimates (e.g., see Appendix B in USDOE 1994b); or (2) emissions factors can be based on generation data specific to the situation of the project (see Section 4.14). In both methods, emissions factors translate consumption of energy into GHG emission levels (e.g., tons of a particular GHG per kWh saved). At the project design stage, we expect most project developers to use default emission factors (method #1); a more detailed discussion of using calculated factors (method #2) is found in Section 4.14.